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U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

3457

VISUAL AIRBORNE TARGET LOCATION SYSTEMS

1. OBJECTIVE

The purpose of this procedure is to outline the test requirements and the methods and techniques of testing necessary for determining the extent to which a Visual Airborne Target Location System (VATLS) satisfies the requirements stated in applicable military requirements, and to determine the suitability of the test item and its maintenance package for U. S. Army use.

2. BACKGROUND

Since early times the U. S. Army has shown continuing improvement in its equipment and weapons of war. Long range artillery weapons, rockets, and sophisticated missiles have replaced the ballistas, the trebuchets and the catapults. There have been corresponding advancements in ammunition, prime movers for moving the weapons and personnel, and electronic and other technical advances which gave the U. S. Army truly great capabilities to shoot, move, and communicate.

The ability to use an advanced weapon system efficiently will depend on corresponding advances in target location techniques. The army requires a system to find the target (visually, by sound, signal emission, etc.) and fix the target location (determine its UTM Coordinates or relative location) with considerable speed and accuracy. Visual airborne target location systems offer great potential for providing target location information of a rapidly moving or reacting enemy or in fluid situations.

Development of visual airborne target location systems using the laser, computer, and state of the art technology require testing to determine suitability for use of the Army in the field.

3. REQUIRED EQUIPMENT

a. A test range compatible with LASER safety requirements.
b. Sites for test item ground components.
c. Support aircraft which, when carrying the aircraft mounted VATLS components, tactical material and operating personnel, are capable of four hour flights or, which have the capability of refueling without engine shutdown.
d. Test equipment for checkout of the VATLS.
e. Surveyed positions for siting of various targets.
f. Ground communication lines from the VATLS Data Analysis Central to various artillery FDC.
g. Landing fields with support facilities.
h. Maintenance support facility for the test item.
i. Photographic support, motion picture and still.
j. Support vehicles.

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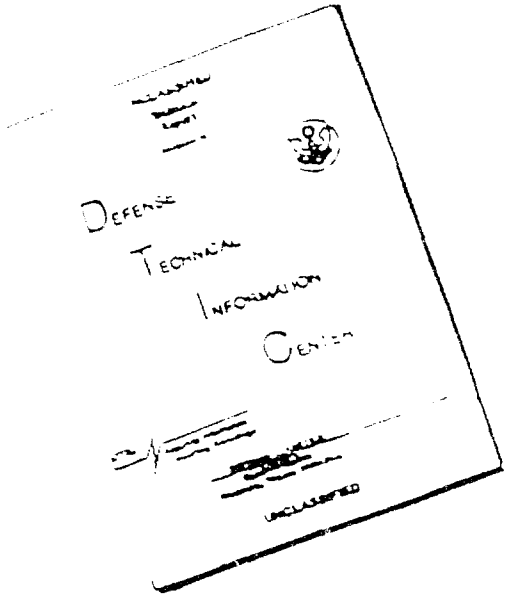

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k. Weighing scales and measuring devices.
1. Shelter and camouflage materials.

4. REFERENCES

A. QMR or SDR for the test item.
B. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
C. USATECOM Regulation 70-23, Equipment Performance Report.
D. USATECOM Laser Safety Guide, 25 November 1968.
E. TB MED 278, Control of Hazards to Health From Laser Radiation.
F. MTP 6-3-500, Physical Characteristics.
G. MTP 6-3-501, Pre-Test Inspection for Service Test.
H. MTP 6-3-502, Personnel Training Requirements.
I. MTP 6-3-510, Transportability of Communication, Surveillance, and Electronic Equipment.
J. MTP 6-3-512, Compatibility with Related Equipment.
K. MTP 6-3-523, Safety.
L. MTP 6-3-524, Maintenance Evaluation.
M. MTP 6-3-525, Human Factors.

5. SCOPE

5.1 SUMMARY

This Materiel Test Procedure describes the preparation for, and the tests to be conducted to determine the suitability of Visual Airborne Target Location as a target systems for Army use. The included subtests are:

a. Preoperational Inspection and Physical Characteristics - A study to determine the physical characteristics of the test item, its condition when received, its packaging, instructional material provided, maintenance spare parts status, and whether or not it is received complete and ready for test.

b. Compatibility of Test Item with Related Equipment - A study to determine compatibility of the airborne components with standard aircraft, operating frequencies with the field electronic equipment, Data Analysis Central with the tactical position environment, and the capability of the components to perform cohesively as a unit in simulated tactical situations.

c. Accuracy Performance - An evaluation of the accuracy of target locations attained by the VATLS operation under various conditions of range.

d. Range Capability - A deterioration of the maximum and minimum ranges of the test item and the effects of range on accuracy.

e. Survey Capability - A study to determine the capability of the test item to accomplish survey of an accuracy acceptable to the field artillery.

f. In-Flight Target Detection-Location - An evaluation of the operators capability of locating targets while in flight using the test item telescope and associated problems.

g. Operational Characteristics - Of airborne equipment, Data Analysis Central equipment, and computer programs.

h. Vulnerability to Detection - A study to determine the susceptibility of the Data Analysis Central equipment to detection.

i. Reliability-Maintainability - A study to determine the reliability and maintainability of the test item, and maintenance problems presented.

j. Safety - A study to determine the test item compliance with safety requirements and to confirm the test item's safety characteristics during conduct of all tests, to comply with requirements of the applicable section of USATECOM Regulation 385-6.

k. Human Factors Engineering - A study to determine the compatibility of the test item with good human factors engineering principles.

l. Transportability - An evaluation of the test item's suitability for transport.

5.2 LIMITATIONS

The tests described in this procedure are based on the VATLS evaluated in 1967. Future VATLS may have components whose names and functions are not yet known, but it is assumed that the operating principles shall be similar. See Appendix A for definitions of the 1967 VATLS components and expressions.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Scheduling

6.1.1.1 Personnel

a. Prior to arrival of the test item ensure that test personnel with backgrounds in the 26W and 35H MOS fields:

1) Have been trained in accordance with procedures outlined in MTP 6-3-502.
2) Have researched available documents relating to the test item, its installation, operation and maintenance.
3) Participate in factory training to learn the details of operating and maintaining the test item first hand, and participate in on-the-job training (OJT) to include:

a) Mounting the airborne components in aircraft.
b) Operating the aircraft mounted components in the airborne mode to gain proficiency in the operation.
c) Operating the complete system to ensure validity of testing during the service test.
d) Maintaining the test item through organizational (O), direct support (F) and general support (H) levels of maintenance.

b. Upon arrival of the test item start a training program for test personnel utilizing as instructors the OJT personnel of step a above.

c. Record the following as regards test personnel and the training program:

1) For all personnel:

a) Name, grade and MOS
b) Specific training or exposure
c) Time in MOS and training in MOS

2) For OJT personnel:

a) Training time at manufacturer's plant and skill level achieved.
b) Time required to become proficient in mounting and operating airborne components and operating the system.
c) Maintenance skill level required.
d) Capability of personnel to perform organizational, direct support and general support maintenance after training.

3) For training session conducted by OJT personnel:

a) Sufficiency of instruction.
b) Skill level of trainees.
c) Ability of trainees to perform duties following instruction.
d) Time devoted to training in various areas of work interest.

4) Adequacy, ease of comprehension and suitability of presentation or sequence of provided training literature.

6.1.1.2 Facilities and Equipment

a. Prior to arrival of the test item ensure that supporting facilities have been scheduled so as to permit maximum meaningful testing. Arrange for:

1) Adequate aircraft, at least two, on test standby and maintenance support and landing fields.
2) Modifications that will permit either four hours of uninterrupted aircraft flight, test item loaded, or the capability of and clearances for, refueling without aircraft shutdown.
3) Targets at surveyed locations.
4) Various surveyed sites for positioning the ground station components.
5) Frequency allocations for the test item-aircraft-airfield combinations.
6) Air maneuver area.
7) Maintenance support facilities for the test item.

b. Upon arrival of the test item, the test officer will:

1) Verify Safety Releases for:

a) The test item and components provided for test.

b) Aircraft mounting of the airborne components and for operating the equipment in the airborne mode.
c) Test item components related equipment combination.

2) Conduct safety classes for test personnel using best source material, stressing the inherent hazards of the test item (if any).
3) Prepare a safety checklist and ensure that all personnel understand its purpose and use.

6.1.2 Preoperational Inspection

Determine the condition of the test item prior to testing by performing the pre-test inspection of MTP 6-3-501 and the following:

a. Visually examine the test item and record evidence of damage to the test item.
b. Record the method and adequacy of packing and packaging.
c. Presence and adequacy of instructional plates, preliminary manuals, log books, maintenance packages, etc.
d. Preoperational services performed, parts replaced, adjustments made, etc.

6.1.3 Physical Characteristics

Determine the physical characteristics of the test item as described in the applicable sections of MTP 6-3-500.

6.2 TEST CONDUCT

6.2.1 Compatibility of Test Item with Related Equipment

Determine test item compatibility with related equipment as described in the applicable sections of MTP 6-3-512 and as follows:

6.2.1.1 Airborne Components

a. During installation of airborne components in the appropriate aircraft, using test personnel determine and record the following:

1) Suitability of mounting instructions.
2) Amount of side and vertical clearance when entering and exiting the aircraft with the test item components.
3) Effect of test item weight distribution on handling capabilities of test personnel.
4) Adequacy of the mounting and operating area inside the aircraft.

b. During operation of the airborne components determine and record the following:

1) Adequacy of work space available to test item operating personnel.
2) Suitability of equipment tiedown or mount, electrical connections and fittings, antenna connections, etc., as applicable.
3) Electrical power generated by the aircraft and test item power requirements.
4) Ability of aircraft operating personnel to efficiently operate and maneuver the aircraft with test item installed, test item operating.
5) Evidence of inductive or capacitative effects brought about by cable and wire locations.
6) Electronic or frequency interference between the test item and aircraft.
7) Evidence of all effects to the test item due to aircraft vibration.

c. During simulated or actual target search determine and record:

1) Suitability of observing ports for optical instruments, both VATLS and other.
2) Problems of continued operation of seek-search by the test item operator as opposed to pilot maneuvering.
3) Problems of varying the direction of search by the operator as opposed to pilot maneuvering.
4) Problems of observed (equipment) orientation during maneuvering.

6.2.1.2 Ground Station (GS) Equipment

During emplacement, operation and displacement of GS equipment record the following:

a. Test item prime mover incompatibility.
b. Electronic or frequency interference between the test item and other equipment in the area. Record those equipments showing evidence of interference.
c. Signature characteristics of the test item.
d. Effects of camouflage on the test item.
e. Problems, such as light requirements, which render its presence in a tactical position undesirable.

6.2.2 Accuracy Performance

Determine the accuracy of target locations provided by the VATLS operation under various conditions of range and aircraft altitude and attitude as follows:

NOTE: 1. Through all accuracy testing vary the LASER ranging mode and ensure that LASER ranging data is recorded to ensure adequate sampling for first return and last return shots

at targets located as follows:

a. On open ground with minimum ground clutter potential
b. In haze and in mist shrouded environments
c. In wooded and/or jungle terrain
d. In dust, fog, rain, sleet, as available during testing

2. As soon as it can be determined that one mode of ranging in a type situation produces marginal or less than acceptable results testing in test mode will be discontinued except for occasional shots to verify the continued presence of those undesirable results under that sighting condition.

6.2.2.1 Aircraft Grounded

Determine the accuracy of ranges provided under the following conditions:

a. With the airborne components aircraft mounted, and with the aircraft at rest on commanding terrain:

1) Take LASER ranging and directional sighting shots to typical military targets of known location sited at the maximum and minimum ranges stated in the military requirements and at varying distances in between.
2) In conjunction with the above, vary the depression angle of the telescope during the ranging as the terrain configuration and siting of the aircraft and targets will permit.
3) In conjunction with the above, vary the observing direction laterally as the terrain and aircraft configuration and aircraft and target siting will permit.

b. With the aircraft stationary but with the aircraft engine(s) running in order to introduce normal flight vibration, repeat the procedures of step a above.

c. Move the aircraft to a point other than that in step a, above, from which point many of the targets used in that test are visible. Take ranging and directional shots to those target plus other visible targets.

d. With the aircraft stationary but with the aircraft engine(s) running, repeat procedures of steps a, b and c, above, and record engine rpm.

e. Compute the location of the targets as follows:

1) Using the readout provided by the VATLS.
2) Using direction and LASER range from each of the aircraft stations as independent computations.
3) Using direction provided from the two aircraft positions but with range determined by GS equipment, and using the two aircraft locations as the base.

6.2.2.2 Aircraft Airborne

Determine the accuracy of ranges provided with the aircraft mounted components airborne, and with the aircraft flying above a surveyed target in the following patterns and situations:

a. Setup No. 1:

1) Aircraft pattern: Circular around target.
2) Height above target area: Approximately 1,000 meters.
3) Telescope Range: Approximately 10 kilometers.
4) Aircraft speed at sighting: Near slowest speed speed shown in military requirement.
5) Tracking Range: Varying based on a.2 and a.3 above.
6) Intercept Angle: Varying, based on a.2 and a.3 above.
7) Depression Angles: Fixed by a.2 and a.3 above.

b. Setup No. 2:

1) Aircraft pattern: Varied to satisfy b.3, below.
2) Height above target area: Approximately 1,000 meters.
3) Telescope Range: Approximately 15 kilometers, except that as the aircraft approaches the maximum rated tracking range, the telescope range will be varied so as to stay within the rated tracking range.
4) Aircraft speed at sighting: Near slowest speed shown in military requirement.
5) Tracking Range: Varying from minimum to rated maximum.
6) Intercept Angle: Varying based on b.2 and b.3, above.
7) Depression Angles: Fixed at the 15 kilometer range but otherwise varying as the flight pattern varies.

c. Setup No. 3:

1) Aircraft Pattern: Circular for one quadrant at two ranges.
2) Height above target area: Approximately 1,000 meters.
3) Telescope Range: Alternating, 8 kilometers and 15 kilometers.
4) Aircraft speed at sighting: Near slowest speed shown in military requirement.
5) Tracking Range: Varying ranges, 2 to 22 kilometers.
6) Intercept Angles: Varying based on c.2 and c.3 above.
7) Depression Angle: Fixed angle for 8 kilometers, another for 15 kilometers.
8) Special: Telescope ranges determined by single sight LASER shot.

d. Repeat Setups 1, 2 and 3, at aircraft altitude approximately 3,000 meters above target.

e. Repeat Setups 1, 2 and 3, at aircraft altitude stated in the military requirements as maximum for the test item.

f. Repeat Setups 1, 2 and 3, at aircraft speed near maximum stated in military requirement.

g. Repeat Setups 1, 2, and 3, with aircraft speed at midpoint of extremes stated in military requirement.

h. Repeat step d, above, with aircraft flying at minimum, maximum, and at midpoint of extremes of speed stated in military requirements.

i. Repeat step e, above, with aircraft flying at minimum, maximum, and at midpoint of extremes of speed stated in military requirements.

j. Perform the following for each sighting taken:

1) Determine and record the coordinates from each sighting.
2) Record the speed of output from one-sight and two-sight methods of target location.
3) Record the radial deviation from surveyed location for each target location provided.
4) For each two-sight mode sighting:

a) Vertical distance between lines of sight
b) Include angle at the target

5) Prepare a diagram detailing actual pattern of aircraft flight depicting aircraft-target-ground station relationship.

6.2.3 Range Capability

Determine and record the maximum and minimum range of the test item, and any degradation of accuracy at various ranges as follows:

a. Observe and take readings on targets up to the limit of the observers ability to detect them or to the ranges stated in the military requirements for the variety of test situations created in paragraph 6.2.2 for the following:

1) Telescope observing range under a variety of atmospheric-visibility conditions.
2) The minimum telescope observing range under a variety of atmospheric-visibility conditions at which the observer can obtain clear resolution of the target.

b. Determine and record minimum, maximum, and optimum tracking ranges during the flights shown in 6.2.2.

c. Determine and record the minimum location ranges for the VATLS under various tracking and telescope range combinations, and altitude and depression angle situations during the flights shown in 6.2.2.

6.2.4 Survey Capability

Determine the accuracy, and the ease of determining and extending survey control using the VATLS, within the intended capabilities of the test item by performing the following:

a. Extend directional control with the GS equipment sited on a surveyed location and with the aircraft tracking system being oriented on a line of known direction as follows:

1) Transmit direction from the attitude reference subsystem to a ground surveying instrument using the reciprocal laying technique.
2) Repeat the preceding step except that the aircraft will either be landed or at one wheel touchdown when the reciprocal laying is accomplished.

b. Extend horizontal and vertical control using both the single-sight and two-sight modes.

c. Compute and record the UTM grid coordinates using the computing subsystem.

d. Sample and record tracking ranges and telescope ranges throughout the limits of the Accuracy Performance testing.

NOTE: In general the survey requirements can be satisfied while carrying out the setups and requirements shown under Accuracy Performance.

e. Based upon the intended survey capabilities of the test item, modify, add to or delete from the survey test situations shown above, to best determine the good points, and limitations of the test item in carrying out field artillery survey operations. Record the results of the modified test situations.

6.2.5 In-Flight Target Detection - Location

Determine the ability of the average airborne observer, in conjunction with the test items optical system, to acquire and locate typical military targets as follows:

a. Position typical military targets such as the following:

1) Jeep, 1/4 Ton
2) 2 1/2 ton truck
3) Self-propelled and towed artillery weapons
4) M109 (type) vans
5) Tents, in size up to general purpose, large

b. Select observers with little or no formal training in aerial observation.

c. Conduct the test in three phases in which the targets are pre-positioned as follows:

1) Phase I:

a) Emplace military vehicles at positions unknown to pilot or observers.
b) Targets will be partially concealed by or under terrestrial vegetation.

d) Movement by personnel in the area of the targets will be kept to a minimum.
e) Test conduct:

(1) Pilot will fly a rectangular pattern around the target area at an altitude of 3,500 feet.
(2) The observer will systematically search the assigned area for targets, unspecified as to location, description, or number.
(3) The co-pilot (or other aerial observer) will assist the primary observer by slewing the test item telescope onto suspect target areas or suspect targets.

2) Phase II:

a) Emplace military vehicles at positions unknown to the pilot or observer.
b) Targets will be placed in open, concealed by camouflage nets.
c) Pilot will fly, standing off from the suspect area a distance of 3.5 kilometers, at altitude 3,500 feet.
d) The observer/co-pilot will perform a detailed search of the suspected area for the targets, unspecified as to location, description, or number.

3) Phase III:

a) Emplace various typical targets incrementally from 2 kilometers out to 13 kilometers from the flight path.
b) Position the targets randomly, and under or concealed by terrestrial vegetation. Following each search run the targets will be repositioned in the target area.
c) The pilot will fly the aircraft at 3,500 feet altitude along a 15 kilometer simulated forward edge of the battle area (FEBA).
d) Observer and co-pilot will search the area in detail for targets.

d. Conduct the various phases of testing during daylight, at approximately one hour before sunrise and one hour before sunset and, when required, under artificial illumination with observers using the naked eye, available and appropriate optical aids and the test item telescope.

NOTE: Alternate observers to eliminate any one-observer bias

e. Vary the test programs indicated above (phases I, II and III) to ensure that the acquisition/location capability is adequately evaluated and determine and record the following:

1) Availability, positioning and adequacy of observing ports from which to view the target area with the unaided eye.

2) Best scanning technique for acquiring target with the test item.
3) Acquisition capability during limited ambient light, under artificial illumination and at nighttime.
4) Value of optical filters in enhancing low light level target acquisition capability.
5) Slant distance that the test targets can be identified under the various lighting conditions, aircraft speeds and flight patterns, and viewing methods.
6) Observing distance the targets begin to blend in with the terrain.

f. Recording any observing problems due to test item-aircraft incompatibility or other reasons such as:

1) Restrictions imposed upon size, etc., of observers because of available work area.
2) Inability to quick slew the telescope and thus severly limiting co-pilot provided aid.
3) Field of view of telescope.
4) Aircraft motion, speed, or exhaust gases.

6.2.6 Operational Characteristics

Determine the operational characteristics of the VATLS (ground station equipment, aircraft mounted components, ancillary items), its functioning reliability and ease of adjustment and replacement as follows:

6.2.6.1 Airborne Equipment

a. Perform the following under both daylight and blackout conditions:

1) Conduct preflight and in-flight checkouts of the airborne equipment and record time required for each.
2) Calibrate and align the airborne equipment and record time required.
3) Using various sized crews install and remove the airborne components and determine and record the following:

a) Average time required
b) Optimum size crew

b. During conduct of step a above and paragraphs 6.2.4 and 6.2.5 determine and record the suitability of the airborne equipment as regards:

1) Auxiliary or quick-orienting sights or speed of orienting the airborne telescope system.
2) Telescope magnifications, filters and field of view.
3) The Attitude Reference System.
4) Time required from equipment power-on to equipment warmed-up.
5) Mission time capability of the aerial platform.

6) Necessity for and frequency of operational adjustment.
7) Stability of alignment.
8) Evidence of telescope reticle oscillation.
9) Maximum and minimum operational depression angle of the telescope.
10) Effects of weather on performance.

6.2.6.2 Ground Station Equipment

a. Perform the following under both daylight and blackout condition:

1) Using various size and emplace and displace the ground station equipment and determine and record the following:

a) Optimum crew size
b) Time required

2) Perform preoperational checkout and record time required.
3) Calibrate and align the GS equipment and record time required.

b. During conduct of step a above, and paragraph 6.2.4 and 6.2.5 determine and record the suitability of the GS equipment as regards:

1) Time required from equipment power on to equipment warmed-up
2) Mission capability time
3) Necessity for and frequency of operational adjustment
4) Ease of operation
5) Stability of alignment
6) Effects of weather on performance
7) Optimum crew size for performing operations

6.2.6.3 Computer Program

Determine and record the suitability of the computer program, its adequacy and limitations to include:

a. Ability to accept and store first sighting data on prescribed number of targets before a second sighting is taken on any of them.
b. Ability to receive data both automatically and from manual inputs.
c. Display of target coordinate data.
d. Ability to accept data non-sequentially.
e. Ability to accept azimuth data from operator up to 6,400 mils.
f. Its versatility in switching from target work to survey work.
g. Ability to accept and utilize sign and codes in addition to number values.
h. Ability to discriminate, to invalidate human error entries.

6.2.6.4 Overall System

Determine and record the suitability of the VATLS as regards the following:

a. Provisions for communication.
b. Standard communication systems and equipment.
c. The angular tracker.
d. The distance measuring system (DMS), data transmission, computer and teletypewriter.
e. Power sources.
f. Shelter and transportation.
g. Accessories.

6.2.7 Vulnerability to Detection

Determine the distance at which the ground equipment can be detected by aided and unaided vision, and the maximum distance the unaided ear can detect the ground station operating under various working conditions, under ambient noise conditions, as follows:

6.2.7.1 Ground Detection

a. Operate the ground equipment generator during daylight without camouflage and have search parties without optical aids, perform the following:

1) Approach the ground station on foot from at least two different directions, separated by approximately 1600 mils.
2) Determine and record the distance from the equipment, and its direction from the search party members when the equipment:

a) Became audible to the unaided ear
b) Became visible to the unaided eye

b. Repeat step a under the following conditions:

1) Air conditioner in operation
2) GS fully operational

c. Repeat the above test with search party personnel using any available and appropriate aids to vision.
d. Repeat steps a and c under the following conditions:

1) Daylight and equipment camouflage
2) Nighttime and equipment with and without camouflage

6.2.7.2 Aerial Detection

With the ground equipment operated during daylight, ranging from one hour before sunrise to sunset determine and record the distance and direction from which the ground station is visible to the aerial observer:

a. To the unaided eye:

1) Without camouflage
2) Camouflaged

b. Using the test item telescope and any other available and appropriate aids to vision:

1) Without camouflage
2) Camouflaged

6.2.8 Reliability - Maintainability

Determine the reliability and service life expectancy and problems of maintaining the test item in the variety of situations outlined in paragraph 6.2.2 through 6.2.7 as described in MTP 6-3-524 and the following:

a. Operate the VATLS as a system for the times specified in the military requirements. During conduct of the various tests determine and record:

1) Operational hours of each component.
2) Failure and frequency of failure, for each component.
3) Minimum and maximum service life, in flying hours, of airborne components without maintenance.
4) The amount of time the ground station components are capable of operating without maintenance.
5) Down time (time to repair) each failure.
6) Mean time to repair (MTTR) of the various failing components and of the system:

   a) At organizational level
   b) At direct support maintenance level
   c) At general support maintenance level

7) Time required to perform:

   a) Daily preventative maintenance
   b) Weekly preventative maintenance

b. Evaluate and record how well the test item and components meet the following criteria:

1) High degree of reliability with minimum number of components.
2) Components of simple design with a minimum of maintenance and service requirements.
3) Separate spare parts kits for maintenance of airborne and ground units.
4) Ease and simplicity of maintenance.
5) Accessibility and interchangeability of component parts.
6) Modular concept of component replacement.
7) Adequacy of systems repair facilities and port stowage.
8) Utilization of common tools and repair parts.

6.2.9 Safety

Confirm that the test item presents no undue safety hazards during

storage, transport, operation and maintenance

NOTE: References 4D and 4E shall be used as a safety guide for both test personnel and the test site.

a. The VATLS and the components will be inspected, operated, and maintained in conformity with the operating instructions provided and MTP 6-3-523.

b. Particular emphasis will be given to evaluating characteristics having safety implications and recording:

1) The presence and clarity of safety plates and markings.
2) Sharp, projecting, or overhanging parts or corners.
3) Exposed or easily contactable moving parts such as gears, fans, or belts.
4) The provisions of fuses or circuit breakers to control the main power input lines, and:
   a) Their accessibility for replacing or resetting while on a mission.
   b) Accessibility to the operator of a main switch for controlling the main input power to all airborne equipment.
5) Protective padding for devices used in proximity to the eyes or the head of personnel, such as eyepieces or viewing devices.

c. During airborne operations the usual rules of flight safety will be observed. In addition, particular attention will be given to observing and recording any apparent safety hazards introduced by:

1) Aircraft mounting of the test component:
   a) Electrical receptacles
   b) Tiedowns and securing devices
   c) Adequacy of mounts and wiring harness
2) Safety wiring and special securing devices to overcome the loosening effects of aircraft vibration.
3) Denial of operating space to pilot or co-pilot or denial of easy access to aircraft controls.
4) Inability of operating personnel to avail themselves of the usual flight safety devices because of the test cargo.

6.2.10 Human Factors Engineering

Throughout all testing evaluate the compatibility of the test item with good human factors engineering principles as described in MTP 6-3-525 and the following:

a. Observe, evaluate, and record those details requiring human attention and action with particular attention to:

1) Illumination, clarity and ease of interpreting the various dials, meters, indices, markings, identifications, and other

indicators.
2) Knobs, levers, handles, fasteners, cables, connectors, controls, and other items which require manual operation.

b. During airborne operation note the conditions under which the operator must work and record:

1) The accessibility and ease of operation of the controls, and the ability to carry out operational requirements.
2) Ability of the operator to make component or part replacement.
3) Effect of aircraft vibration upon operator performance.

c. At the ground control station note the following and record:

1) Ability of operating personnel to carry out the physical requirements of ground station operation.
2) Ease of making the electrical hookups for ground station equipment.
3) Ease of operating the equipment during daylight and under blackout conditions.

d. Determine and record the presence of any other factors which reduces the operator equipment compatibility.

6.2.11 Transportability

Evaluate test item for suitability of transport as outlined in MTP 6-3-510.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personnel Training

Record the following:

a. For all personnel:

1) Name, grade and MOS
2) Specific training or exposure
3) Time in MOS in months
4) Training time in MOS in months

b. For OJT personnel:

1) Training time at manufacturer's plant in weeks
2) Skill level achieved
3) Time required to become proficient in:

a) Mounting the airborne components in the aircraft.

b) Operating the aircraft mounted components in the airborne mode.
c) Operating the complete system.

4) Maintenance skill level required.
5) Capability to perform organizational, direct support and general support maintenance.

c. For training session conducted by OJT personnel:

1) Sufficiency of instruction
2) Skill level of trainees
3) Ability of trainees to perform duties after instruction
4) Time, in hours, devoted to various areas of work interest

d. For training literature provided:

1) Adequacy
2) Ease of comprehension
3) Suitability of presentation or sequence

6.3.1.2 Facilities and Equipment

Record the following:

a. Complete identification of support including:

1) Aircraft makes, models and serial numbers.
2) Survey locations of targets and ground station sites.
3) Frequencies allocated, used.
4) Description of targets as to type and size, and the presence of and degree of camouflaging.

b. Pertinent data concerning the Safety Release and ensure that a copy is filed with the project file.

6.3.1.3 Preoperational Inspection

Record inspection data collected as described in the applicable section of MTP 6-3-501 and the following:

a. Any evidence of damage to the test item components.
b. Method and adequacy of packing and packaging.
c. Presence and adequacy of instructional plates, preliminary manuals, log books, maintenance packages, etc.
d. Any preoperational services performed, replacement parts, etc.

6.3.1.4 Physical Characteristics

Record data collected as described in the applicable sections of MTP

6-3-500.

6.3.2 Test Conduct

6.3.2.1 Compatibility with Related Equipment

Record data collected as described in the applicable sections of MTP 6-3-512.

6.3.2.1.1 Airborne Components -

Record the following:

a. During installation:

1) Suitability of mounting instructions.
2) Amount of side and vertical clearance during entrance/exit in inches.
3) Effect of test item weight distribution on personnel handling capabilities.
4) Adequacy of aircraft mounting and operating area.

b. During operation:

1) Adequacy of available workspace.
2) Suitability of:

a) Equipment tiedown or mount
b) Electrical connections and fittings
c) Antenna connections

3) Aircraft generated electrical power in volts and amperes.
4) Test item power requirements in volts and amperes.
5) Ability of aircraft operating personnel to efficiently operate and maneuver the aircraft with:

a) Test item installed
b) Test item operating

6) Evidence of inductive or capacitative effects due to wire and cable locations.
7) Electronic or frequency interference between test item and aircraft.
8) Effect of aircraft vibration on test item.

c. During simulated or actual target search:

1) Suitability of observing ports for:

a) VATLS optical equipment

b) Other optical equipment

2) Seek-search problems not caused by pilot maneuvering.
3) Problem of varying direction of search not caused by pilot maneuvering.
4) Problems of observer (equipment) orientation during maneuvering.

6.3.2.1.2 Ground Station (GS) Equipment -

Record the following:

a. Test item prime mover incompatibility.
b. For electronic or frequency interference, when applicable:

1) Frequency in Hz
2) Equipment involved

c. Signature characteristics of test item.
d. Effects of camouflage.
e. Situations making test item presence in tactical position undesirable.

6.3.2.2 Accuracy Performance

Record the following for each sighting taken:

a. Type terrain (open ground, wooded land, etc.)
b. Weather conditions (haze, mist, clear, fog, etc.)

6.3.2.2.1 Aircraft Grounded -

Record the following for each reading taken:

a. Aircraft condition (engine off, engine on)
b. Engine speed in rpm, if applicable
c. Ground location of optical telescope
d. Ground location of aircraft
e. For each sighting:

1) Identification of the target
2) Location of target relative to observing telescope
3) LASER indicated range to each target sighted, in meters
4) Depresssion angle to each target sighted in degrees
5) Telescope line of sight in relation to line of the aircraft
6) Coordinates of the target from the one-sight method

f. Location of the target using the two-sight (triangulation) method

6.3.2.2.2 Aircraft Airborne -

a. Record the following for each sighting:

1) Atmospheric condition (calm, turbulent).
2) Visibility (good, fair, etc.).
3) Aircraft pattern.
4) Aircraft height above target area in meters.
5) Telescope range in kilometers.
6) Aircraft speed in mph.
7) Tracking range in meters.
8) Intercept angle in degrees.
9) Depression angle in degrees.
10) Coordinates determined from each sighting.
11) Speed of output from:

a) The one-sight method of target location
b) The two-sight method of target location

12) Radial deviation from surveyed location for each target location provided.
13) Vertical distance between lines of sight in the two-sight mode.
14) The included angle at the target in the two-sight mode.

b. Retain aircraft-target-ground station relationship diagrams.

6.3.2.3 Range Capability

Record the following:

a. Minimum and maximum tracking ranges achieved.
b. Accuracy attained at those ranges.
c. Minimum and maximum telescope ranges achieved.
d. Accuracy attained at those ranges.
e. Minimum and maximum total ranges achieved.
f. Accuracy attained at those ranges.
g. Record any additional data which has potential value in evaluating the range capability of the VATLS and any deterioration of accuracy attributable to range.

6.3.2.4 Survey Capability

Record the following:

a. All cases where the survey information and the VATLS provided information for:

1) UTM coordinates of targets located by VATLS:

a) From ranges provided by the one-sight mode
b) From ranges provided by the two-sight mode

2) Distances determined by VATLS:

a) From the one-sight mode

b) From the two-sight mode

b. Problems discovered in utilizing the VATLS as an aid to survey, such as:

1) Ability of the ground instrument operator to orient on the airborne telescope and vice versa.
2) Any problems associated with directional control from the landed backsight modes.
3) Any problems of putting the VATLS survey data into the computer.
4) Usability of the computer output:

a) As to accuracy of computations
b) As to degree of precision
c) As to format

6.3.2.5 In-Flight Target Detection-Location

Record the following:

a. For each target sited:

1) Military nomenclature, size, whether or not canvas was installed, whether antenna erected, etc.
2) UTM coordinates of each target sited.
3) Type and degree of concealment, such as:

a) Open terrain, wooded, rocky hillside, etc.
b) Target in open, under trees, camouflaged, etc.
c) Degree of activity, frequency of movement around target.

b. For observing conditions:

1) Atmospheric conditions
2) Clock time
3) Observing direction in relation to sun
4) Observer-target-light source relationship

c. Availability, positioning and adequacy of observing ports using unaided vision.
d. Best scanning technique.
e. Acquisition capability:

1) Under limited ambient light
2) Under artificial illumination
3) At nighttime

f. Value of optical filters in enhancing low light level target acquisition capability.
g. Short ranges at which the target can be identified, in meters,

under various conditions:

1) Lighting condition (dusk, daylight, etc.).
2) Method of viewing (unaided vision, acceptable optics, test item telescope).
3) Aircraft speed in mph.
4) Flight pattern.

h. Observing distance at which the target begins to blend into the terrain, for each situation, in meters.

i. Observing problems due to test item - aircraft incompatibility.

6.3.2.6 Operational Characteristics

6.3.2.6.1 Airborne Equipment -

a. Record the time required, in minutes, to perform the following under daylight and blackout conditions:

1) Pre-flight checkout of the airborne equipment
2) In-flight checkout of the airborne equipment
3) Calibrate and align the airborne equipment
4) Install the airborne equipment
5) Remove the airborne equipment

b. Record the following, in minutes:

1) Time from power on to warmups
2) Mission capability time of the aerial platform
3) Time required to orient the airborne telescope system

c. Record the following:

1) Optimum size crew to:

a) Install airborne equipment
b) Remove airborne equipment

2) Suitability of auxiliary or quick-orienting sights, if applicable.
3) Suitability of the Attitude Reference System.
4) Necessity for and frequency of operational adjustment
5) Stability of alignment
6) Evidence of telescope reticle oscillation
7) For telescope depression angle, in degrees:

a) Maximum
b) Maximum operational

8) Suitability of telescope:

a) Magnification
b) Filters
c) Field of view

9) Effects of weather on performance

6.3.2.6.2 Ground Station Equipment -

a. Record time required, in minutes, to perform the following under daylight and blackout conditions:

1) Emplace the ground station equipment
2) Displace the ground station equipment
3) Perform operational checkout
4) Calibrate and align the GS equipment

b. Record the following, in minutes:

1) Time required from equipment power on to equipment warmup
2) Mission capability time

c. Record the following:

1) Necessity for and frequency of operational adjustment
2) Ease of operation
3) Stability of alignment
4) Effects of weather on performance
5) Optimum crew size to:

a) Emplace GS
b) Displace GS
c) Operate equipment

6.3.2.6.3 Computer Program -

Record the following:

a. Number of first sightings that can be stored before second sightings commence.
b. Ability to accept data from automatic and manual inputs.
c. Clarity of coordinate display.
d. Versatility in:

1) Accepting data non-sequentially
2) Switching from target locations to survey computations

e. Any restrictions or problems of accepting azimuth data up to 6400 mils.
f. Ability to accept signs and identifying codes.
g. Ability to minimize human error operations.

6.3.2.6.4 Overall System -

Record the suitability of the following:

a. Provisions for communication
b. Standard communication systems and equipment
c. The angular tracker
d. The DMS and data transmission
e. The computer and teletypewriter
f. Power sources
g. Shelter and transportation means
h. Accessories

6.3.2.7 Vulnerability to Detection

a. Record the following for each aural detection:

1) GS equipment condition (generator only, air conditioner only, fully operational).
2) Distance, in meters, GS equipment became audible.

b. Record the following for each visual observation:

1) GS equipment condition (with camouflage, without camouflage)
2) Time of test (day, night)
3) Location of observer (airborne, ground)
4) Method of observation (unaided vision, optical aid)
5) Distance, in meters, GS became visible

6.3.2.8 Reliability - Maintainability

Record data collected as described in the applicable sections of MTP 6-3-524 and the following:

a. Operational hours of each component.
b. Failure and frequency of failures of each component.
c. Downtime (time to repair) each failure, in hours.
d. Minimum and maximum service life in flying hours of aircraft mounted components without maintenance.
e. Amount of time the ground station components are capable of operating without maintenance, in hours.
f. Mean time to repair the various failing components of the system, in hours:

1) At organizational level
2) At direct support level
3) At general support level

g. Usability of standard tools and repair parts.
h. Simplicity and ease of maintenance.
i. Presence of separate repair part kits for airborne and ground station components.
j. The accessibility and interchangeability of component parts.

k. Adequacy of maintenance facilities and part stowage.
l. Test personnel comments, when applicable, on:

1) Reliability of components
2) Simplicity of component design
3) Modular concept of component replacement

6.3.2.9 Safety

Record data collected in the applicable sections of MTP 6-3-523 and the following:

a. Presence, adequacy and ease of understanding safety plates and markings.
b. The presence of fuzes or circuit breakers to control the main power input lines:

1) Their accessibility for replacing or resetting
2) The presence and accessibility of a main power input switch

c. The presence of projecting and overhanging parts or corners, or easily contactable moving parts such as gears, fans, and belts.
d. The presence of any safety hazards occasioned by aircraft mounting of the test components, such as:

1) Suitability of electrical receptacles
2) Adequacy of mounts and wiring harness
3) Adequacy of tiedowns and securing devices

e. The presence of crossing, criss crossing or dangling wires, cables or connections.
f. Any denial of safety caused by the test component, its mounting devices, or component-aircraft incompatibility.

6.3.2.10 Human Factors Engineering

Record data collected so described in the applicable sections of MTP 6-3-525 and the following:

a. Adequacy, accessibility, and ease of comprehension of dials, meters, indices, markings, identifications, and other indicators.
b. Adequacy and accessibility of and work effort required to manipulate knobs, handles, levers, fasteners, cables, connectors and controls, and other items requiring manual operation.
c. During airborne operations:

1) The accessibility and ease of operation of the controls and the operators ability to carry out operational requirements.
2) Ability of the operator to affect components or part replacement.
3) Effect of aircraft upon operation ability.

d. Ground Station:

1) Ability to perform operational requirements
2) Ease of carrying out warmups
3) Ability to operate the equipment inside any shelter provided:

a) During daylight
b) Under blackout conditions

e. The presence of any other operator-equipment non-compatibility.

6.3.2.11 Transportability

Record data as outlined in MTP 6-3-510

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Data Reduction

a. Determine, based on data gathered in 6.2.3.a through c, the minimum, maximum, and optimum:

1) Telescope range
2) Tracking range
3) VATLS location range

b. Determine, based on data gathered in 6.2.3.a through c, the point at which range accuracy is degraded for each of the conditions sampled.

6.4.2 Data Presentation

All data collected during the test shall be collated and placed in concise workable form and presented as described in the applicable MTP or as follows:

a. These data will be analyzed to determine:

1) Whether or not the test objectives were met.
2) Whether or not the test item meets established criteria.
3) Whether or not the test item fulfills a military need.
4) Whether or not the test item is suitable for and recommended for field military use.

b. Results of testing will be presented in narrative form supplemented, as required, with tables, graphs, charts, photographs, and motion pictures.

c. Where opinions or judgments of test personnel are presented they will be identified as such.

d. A Safety Confirmation based on the data of paragraph 6.3.10 shall be presented in accordance with USATECOM Regulation 385-6.

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APPENDIX A

DEFINITIONS

1. Aircraft Mounted Components

a. Stabilized Telescope System (STS) - The STS is the means by which the observer views the target from the aircraft. It has the capability:

1) To provide azimuth and elevation angles of the telescope line of sight with respect to the aircraft.
2) To direct a LASER ranging pulse at a target.
3) Selectible magnifications.

b. Attitude Reference Subsystem (ARS) - the ARS consists of an automatic gyro compassing platform attached to the telescope. It provides roll, pitch, and yaw angles of the aircraft attitude with respect to the reference coordinate system.

c. LASER Ranging Subsystem (LRS) - The LRS consists of:

1) A LASER transmitter which generates a light pulse which is beamed through the telescope.
2) A LASER receiver which detects the light "echo" returned from the target and determines slant range.

d. Transponder - Is interrogated by the ground based DMS transmitter thereby allowing determination of slant range DMS to Transponder.

2. Data Analysis Control (Ground Station (GS))

The GS components referred to in this MTP are:

a. Distance Measuring Subsystem (DMS) - The DMS is used:

1) To determine slant range DMS to transponder
2) To provide an air-ground and ground-air link

b. Aircraft Tracking Subsystem (ATS) - The ATS is an angular tracker which:

1) Tracks the airborne beacon signal
2) Provides the angular position of the aircraft

c. Computing Subsystem (CS) - The CS consists of an M18 gun direction computer, a teletypewriter, and buffering equipment:

1) The CS accepts:

a) Output of the air-ground data link
b) Range information from the DMS
c) Angular information from the ATS

2) The CS provides:

a) A display of target coordinates and height
b) Printout of the complete target report

3. VATLS Oriented Expressions

Expressions used in this MTP which are VATLS influenced are:

a. First Return-Last Return: - A term used in LASER ranging indicating the return 'echo' from the first and last targets or reflecting surfaces on line. In a forest the first return would probably be the tree canopy; the last return, the ground below the canopy.

b. Single Sight-Two Sight: - In the single-sight mode the LASER determined range is used to fix the target, as in Polar plotting. In the two-sight mode the location of the target is fixed by intersections of angular readings from the aircraft telescope using the various aircraft positions at sighting as the base.

c. Tracking Range - Slant range from the DMS to the airborne telescope (or Transponder).

d. Telescope Range - Slant range from the aircraft to the target.

e. Black Box Concept (if maintenance) - Removal and replacement by module as opposed to individual item.

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13. ABSTRACT

This Army Service Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Visual Airborne Target Location Systems, and for determining their suitability for service use by the U. S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

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